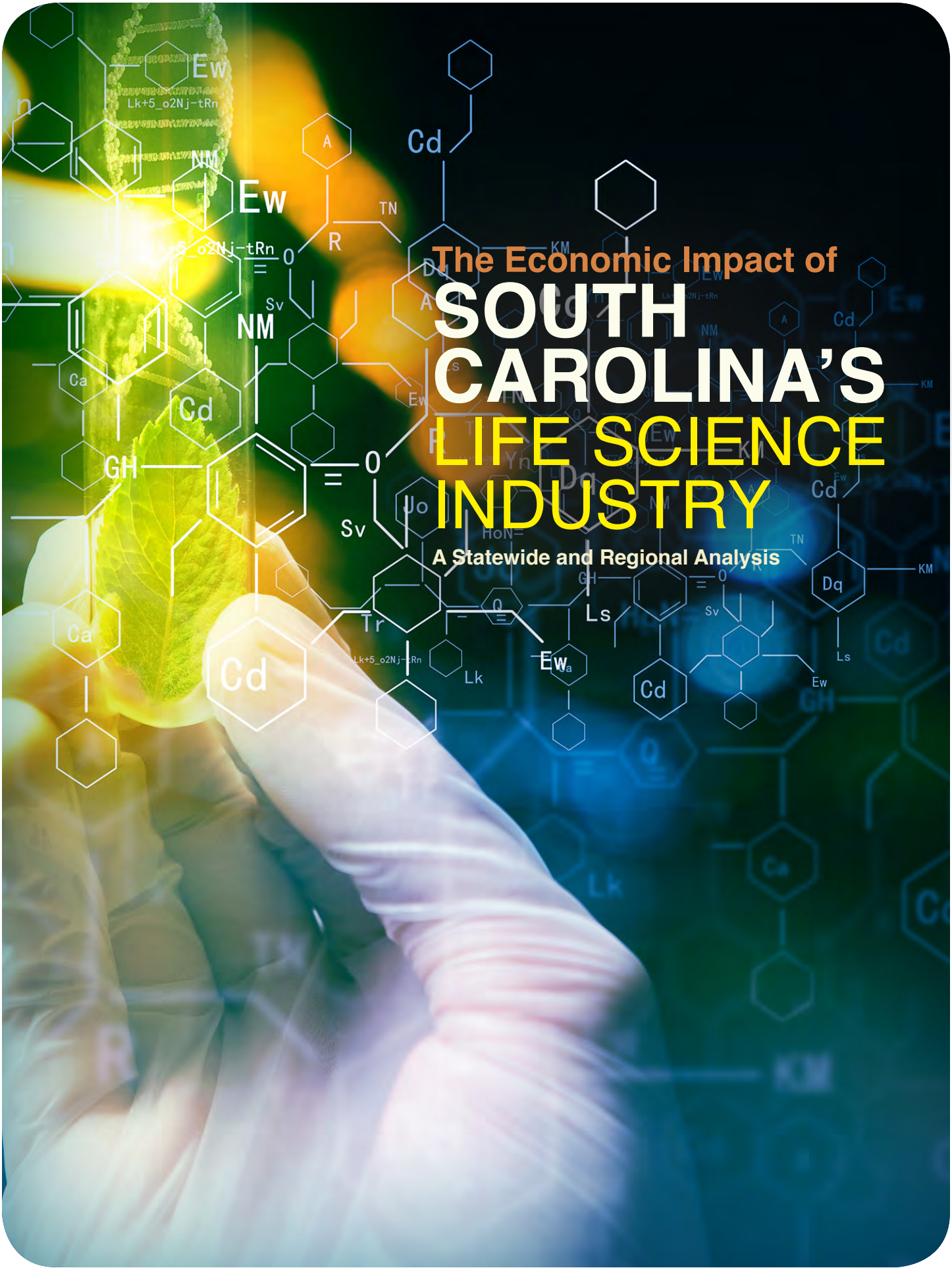

The Economic Impact of SOUTH CAROLINA'S LIFE SCIENCE INDUSTRY

A Statewide and Regional Analysis

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Executive Summary

- *South Carolina's life science industry has been one of the fastest growing sectors over the past decade and has been a major contributor to the state's current economic expansion. Since 2005, annual employment growth within the life science industry has averaged approximately 1.7 percent, which is more than twice that of the state as a whole over the same time period (0.8%).*

- *The life science industry in South Carolina currently consists of approximately 15,012 employees across 402 firms. Employment is most concentrated within firms specializing in bioscience-related distribution and medical devices & equipment.*

- *The life science industry supports a significant demand for high-wage, high-skill jobs in various STEM fields (science, engineering, technology, mathematics, and related occupations). Specifically, the average direct job in the life science industry in South Carolina pays an annual total compensation of $78,658, which is approximately 95 percent higher than the average annual compensation in South Carolina across all jobs ($40,293).*

- *Because of the high degree of innovation occurring through various research and testing activities, the life science industry directly supports South Carolina's knowledge economy. The knowledge economy is defined as consisting of any sector that regularly creates and successfully commercializes new ideas. Because of its contributions to the knowledge economy, the life science industry generates significant productivity gains for South Carolina. Enhancing growth within industries that boost productivity is critical for the long-run economic health of the state.*

- *The annual economic impact of the life science industry on the state of South Carolina totals approximately $11.4 billion in total economic output. This figure reflects the dollar value of all goods and services that can be attributed (either directly or indirectly) to life science-related firms in South Carolina. This $11.4 billion in economic output is associated with 43,467 total jobs and over $2.5 billion in labor income.*

- *The total economic impact resulting from the life science industry is associated with an employment multiplier of 2.9. This implies that for every 10 jobs that are created within the life science industry in South Carolina, an additional 19 jobs are created elsewhere in the state.*

- *The volume of ongoing research and the number of new patents issued are both measures of the status of innovation-related life science activities in the pipeline that will contribute to the future growth of the industry. Both indicators in South Carolina have shown an overall positive rate of growth in recent years. South Carolina venture capital investment in the life science industry is currently targeted towards the categories of Drugs, Pharmaceuticals, Medical Devices, and Equipment. These categories also represent the majority of the life science industry in South Carolina that is directly tied to innovation.*

- *In order to assess the perceived strengths and weaknesses of the life science industry from the firm perspective, a series of firm-level interviews of life science companies in South Carolina were conducted. The primary results of these interviews indicate that while firms anticipate high market demand and have a favorable view of the overall business climate in South Carolina, they also consistently note that there is a shortage of high-skilled workers in the state. Addressing this need has the potential to improve the state's overall competitiveness and to enhance the long-run growth potential of the life science industry.*

Section I – Introduction and Background

The economies of both South Carolina and the United States have improved dramatically since the end of the Great Recession that occurred from 2007 to 2009. In South Carolina, for example, the unemployment rate dropped from its peak of 11.7 percent in December 2009 to 4.3 percent in December 2016 while wage growth recently reached its highest level since 2011.[1] One of the fastest growing sectors over the past decade and one that has been a major contributor to this current economic expansion is the life science industry. Since 2005, the annual employment growth rate for South Carolina's life science industry has averaged approximately 1.7 percent, which is more than twice that of the state as a whole over the same time period (0.8%).

Although there is no official definition provided by the federal government, the life science industry can be broadly defined as encompassing firms in the fields of biotechnology, pharmaceuticals, biomedical technologies, biomedical devices, life systems technologies, food processing, and any organization that is actively engaged in the various stages of research, manufacturing, and distribution of products within these fields. In South Carolina, the life science industry is directly supported by the S.C. Biotechnology Industry Organization (SCBIO). SCBIO is a member organization that exists with a specific mission to support and advance South Carolina's life science industry through collaboration, advocacy, workforce development, and support for business operations.

A strong life science industry offers a number of advantages to South Carolina. First, growth in the life science industry introduces a significant demand for high-wage, high-skill jobs in various STEM fields (science, engineering, technology, mathematics, and related occupations).

[1] Source: U.S. Bureau of Labor Statistics (QCEW)

Second, the life science industry is contributing to the development of the state's knowledge economy. The knowledge economy generally consists of industrial sectors that require innovation and technological development along with the commercialization of new ideas. This process – innovation and commercialization – is what leads to long-run economic growth and development. Regions with high concentrations of workers in the knowledge economy (such as the high-tech STEM fields mentioned above) generate large volumes of human capital resources and knowledge spillover effects. In the United States, regions with a well-educated workforce and a strong innovation sector are those that are growing the fastest and have workers who are among the most productive, creative, innovative, and well paid in the country.[2] In South Carolina, regions with the highest number of jobs in the knowledge economy are the regions currently experiencing the fastest rates of income growth – both for those working in the knowledge economy and for those working in the supporting service sectors.

Third, the knowledge economy is a key factor in improving a region's rate of productivity growth. Regional economies have two primary ways of boosting long-run economic growth: (1) increasing labor force growth; and (2) increasing productivity growth. Because of current demographic trends in the United States, any attempt to significantly boost economic growth by increasing the size of the labor force will likely have minimal effects.[3] This implies that the primary strategy for increasing long-run economic growth should be boosting productivity. This, in turn, implies that growth in the knowledge economy should be at the forefront of economic development efforts.

Each of these three advantages clearly illustrate why the life science industry represents such a critical element to South Carolina's future economic growth. The purpose of this study is to provide a detailed analysis of the life science industry in South Carolina and to estimate the industry's current influence and overall statewide presence. Additionally, this study will conduct a review of academic research and private investment in the life sciences to determine whether any mismatch exists between the academic and investment priorities within the life science industry in South Carolina and general industry demand. Finally, this study will report the results of a series of firm-level interviews of life science companies in South Carolina to provide perspective on the perceived strengths and weaknesses of the life science industry from local firms operating from within it.

[2] For a full discussion on the benefits of knowledge economies in the United States, see Moretti, E., (2012). *The New Geography of Jobs.* New York: Houghton Mifflin Harcourt.
[3] These demographic trends include, among other things, the aging and retiring of the baby boomer generation.

Section II – The Economic Impact of the Life Science Industry in South Carolina

Defining the Life Science Industry

In order to formalize the broad definition of the life science industry outlined above, SCBIO and the South Carolina Department of Commerce (SC Commerce) jointly identified the 25 NAICS (North American Industrial Classification System) codes into which South Carolina's life science firms are primarily concentrated. Since each firm in South Carolina is tied to a specific six-digit NAICS code, it is possible to identify all of the firms that are associated with this NAICS code list.

These 25 NAICS codes are aggregated into the following major industry categories:

- Agricultural Products
- Drugs and Pharmaceuticals
- Medical Devices and Equipment
- Research, Testing, and Medical Laboratories
- Bioscience-Related Distribution

The process of matching these 25 NAICS codes to individual firms is accomplished through the use of the Hoover's database. Hoover's Inc. is a subsidiary of Dun and Bradstreet and is based out of Austin, Texas. The Hoover's database is one of the largest commercial databases available, containing firm-level information on over 85 million companies across more than 1,000 industry segments. Among the variables that the Hoover's database tracks for each firm is the six-digit NAICS code. Thus, firms that are categorized within the life science industry can be successfully identified by matching the appropriate life science NAICS codes to the Hoover's list of South Carolina firms.

SC Commerce was able to obtain the most recent listing of all companies in South Carolina from Hoover's and to perform this match for all life science NAICS codes.[4] The matched dataset was then manually inspected to ensure accuracy and the resulting firm list is what will be denoted for the remainder of this report as constituting the life science industry in South Carolina.

As of February 2017, the life science industry in South Carolina contains approximately 15,012 employees across 402 firms. Note that the majority of the industry falls within the categories of Medical Devices & Equipment and Bioscience-Related Distribution.

[4] All firm-level data obtained through SC Commerce are current as of February 2017.

A summary of the life science industry appears below in **Table 1.**

Table 1 – The Life Science Industry in South Carolina

AGRICULTURAL PRODUCTS			
NAICS	**Description**	**#of Firms**	**Total Employment**
311221	Wet Corn Milling	2	97
311222	Soybean Processing	0	0
311223	Other Oilseed Processing	0	0
325193	Ethyl Alcohol Manufacturing	1	15
325221	Cellulosic Organic Fiber Manufacturing	0	0
325311	Nitrogenous Fertilizer Manufacturing	4	40
325312	Phosphatic Fertilizer Manufacturing	0	0
325314	Fertilizer (Mixing Only) Manufacturing	1	6
325320	Pesticide and Other Agricultural Chemical Manufacturing	7	424
DRUGS AND PHARMACEUTICALS			
NAICS	**Description**	**#of Firms**	**Total Employment**
325411	Medicinal and Botanical Manufacturing	4	125
325412	Pharmaceutical Preparation Manufacturing	38	2,102
325413	In-Vitro Diagnostic Substance Manufacturing	0	0
325414	Biological Product (except Diagnostic) Manufacturing	6	54
MEDICAL DEVICES AND EQUIPMENT			
NAICS	**Description**	**#of Firms**	**Total Employment**
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing	13	300
334516	Analytical Laboratory Instrument Manufacturing	6	60
334517	Irradiation Apparatus Manufacturing	2	210
339112	Surgical and Medical Instrument Manufacturing	14	931
339113	Surgical Appliance and Supplies Manufacturing	24	2,090
339114	Dental Equipment and Supplies Manufacturing	1	8
RESEARCH, TESTING, AND MEDICAL LABORATORIES			
NAICS	**Description**	**#of Firms**	**Total Employment**
541380*	Testing Laboratories	23	551
54171*	R&D in the Physical, Engineering, and Life Sciences	31	559
621511	Medical Laboratories	63	1,865
BIOSCIENCE-RELATED DISTRIBUTION			
NAICS	**Description**	**#of Firms**	**Total Employment**
423450	Medical, Dental, & Hospital Equp. and Supplies Merchant Whslrs.	90	2,477
424210*	Drugs and Druggists' Sundries Merchant Wholesalers	26	557
424910*	Farm Supplies Merchant Wholesalers	46	2,541
	Totals	**402**	**15,012**

*includes only the portions of industries engaged in relevant life science activities

Economic Impact Methodology

Although the total volume of economic activity as measured in Table 1 is significant, it does not provide a complete picture of the impact of the life science industry on South Carolina's economy. The expenditures that occur as part of the ongoing operations of these 402 firms represent direct economic activity of life sciences within South Carolina. However, these expenditures also lead to additional job creation and economic activity throughout the state by way of the economic multiplier effect (or economic ripple effect).

Economic multiplier effects can be divided into direct, indirect, and induced impacts. The direct effect represents all in-state purchases made by firms operating within the life science industry. These may include, for example, employee wages and benefits, construction materials purchased, computer equipment, or other overhead and administrative costs. This spending increases demand for goods and services and leads to the creation of new jobs and more income for employees and suppliers of firms within the life science industry.

The indirect effect reflects all of the additional economic impacts resulting from inter-industry linkages between other local businesses in South Carolina. For example, a medical equipment manufacturer may need to purchase various plastic components as raw inputs for the medical equipment being manufactured and assembled. In this situation, in-state plastic manufacturers may see an increase in demand, which would require them to purchase additional supplies from their own vendors and to potentially hire additional employees if the increase in demand were large enough. The vendors of the plastic manufacturers would then see an increase in demand and have to purchase additional inputs as well, and so on. These indirect effects would thus ripple throughout the state's economy.

The induced effect reflects additional economic activity that results from increases in the spending of household income. For example, when the aforementioned medical equipment manufacturer enters the South Carolina market, it hires employees who earn an income. These employees then spend part of their income locally on, for example, food, entertainment, or housing. These industries will then see an increase in demand for their goods and services, which will lead to higher incomes for some of their employees, part of which will also be spent locally.

These successive rounds of indirect and induced spending do not go on forever, which is why we can calculate a value for each of them. In each round, money is "leaked out" for a variety of reasons. For example, firms may purchase some of their supplies from vendors located outside of the local area. In addition, employees will save part of their income or spend part of it with firms located outside of South Carolina. In order to determine the total economic impact that will result from an initial direct impact, economic multipliers are used. An economic multiplier can be used to determine the total impact (direct, indirect, and induced) that results from an initial change in economic activity (the direct impact). Multipliers are different in each sector of the economy and are largely determined by the size of the local supplier network as well as the particular region being examined. In addition, economic multipliers are available to calculate not just the total impact, but also the total employment and income levels associated with the total impact.

To estimate the economic impacts in this study, a detailed structural model (known as an input-output model) of South Carolina that contains specific information on economic linkages between all industries within the state was used. This study utilized the input-output modeling software IMPLAN to calculate all estimates.

Primary Results

The structural input-output model estimates economic impacts in terms of three specific measures that will be used in this report: economic output, employment, and labor income. Economic output is simply defined as the dollar value of the final goods and services purchased that can be attributed (directly or indirectly) to all business activity within the life science industry. It can also be thought of as an aggregate measure of total spending resulting from an initial direct expenditure. Because it includes all spending by consumers and businesses on both goods and services, it is an all-inclusive measure of the impact on total economic activity. Employment measures the impact on jobs in terms of the total number of FTE positions.[5] Labor income represents total employee compensation, including wages, salaries, and benefits.

[5] FTE refers to full-time equivalent positions.

As described above, there are currently 402 firms in South Carolina's life science industry that employ approximately 15,012 employees across the state. This represents the direct impact of the industry, which then leads to indirect and induced impacts through increases in demand for goods and services in other related local industries and through increases in household spending activity – all of which are estimated using economic multipliers. Each impact is reported in Table 2, along with the accompanying totals. These totals represent the overall impact of the life science industry on the state of South Carolina.

Table 2 - Economic Impact of the Life Science Industry in South Carolina

	Employment	Labor Income	Economic Output
Direct Impact	15,012	$1,180,809,633	$7,300,995,264
Indirect Impact	16,160	$874,621,999	$2,557,715,922
Induced Impact	12,295	$476,643,505	$1,587,869,009
Total Impact	43,467	$2,532,074,137	$11,446,580,195

Note first that the direct impact of 15,012 employees is estimated to directly support approximately $7.3 billion in economic activity across South Carolina. In other words, the 402 firms identified as representing the life science industry generates approximately $7.3 billion worth of economic output every year.

This $7.3 billion also leads to an additional $2.6 billion in indirect effects, which is the estimated total dollar value of the increased demand for goods and services of local suppliers that result from the $7.3 billion in direct procurement activity among the 402 life science companies. This direct output also leads to another $1.6 billion in induced effects, which represents the total increase in household spending that occurs across a variety of industries in South Carolina. The combination of the direct, indirect, and induced impacts leads to a total impact of $11.4 billion on the state of South Carolina that is associated with the life science industry.

Table 2 also details the indirect and induced impacts for labor income and employment. The $2.6 billion in indirect effects is associated with 16,160 additional employees working to fill the increased demand for industry related local suppliers. This indirect employment is also associated with nearly $875 million in additional labor income. Another 12,295 employees are supported through the nearly $1.6 billion estimated induced impact. These are employees who work in industries that experience an increase in demand due to increased household spending. For example, if an overhead-related purchase for a life science firm led to an increase in demand for a particular supplier, this would lead to additional income for some of the supplier's employees. Additional spending on the part of the supplier's employees that results from their increased income reflects the induced impact. This spending leads to increased demand in a variety of industries that ultimately supports these 12,295 jobs, $1.6 billion in economic output, and $477 million in labor income.

Employment Growth: Quantity vs. Quality

The primary means by which economists measure the health of a local region (or state) is through its rate of employment growth and income growth. Simply put, a regional economy does well when it is producing new jobs and generating wage gains for existing jobs at a relatively rapid pace. Thus, both job quantity and job quality matter if the goal is to produce healthy, long-run economic growth.

In South Carolina, the life science industry is contributing both to employment quality and to employment quantity. For example, the economic impact results detailed in **Table 2** reveals a high employment multiplier effect that is documented in **Figure 1.**

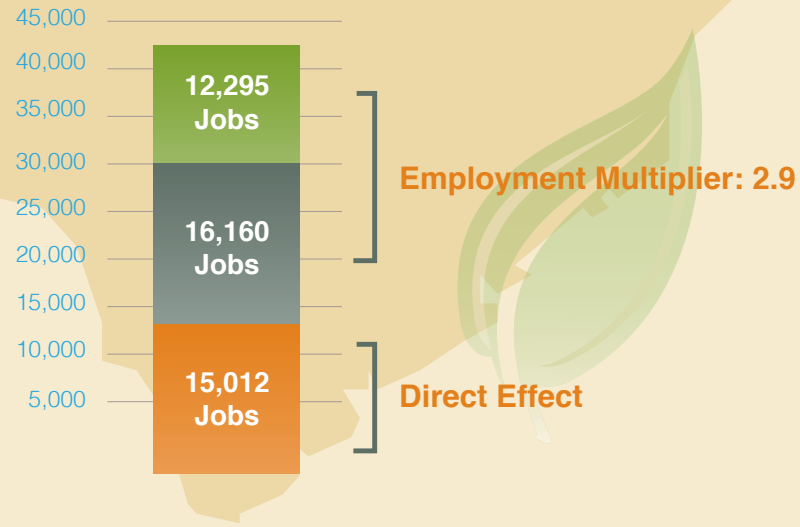


Figure 1
The Employment Multiplier Effect of the S.C. Life Science Industry

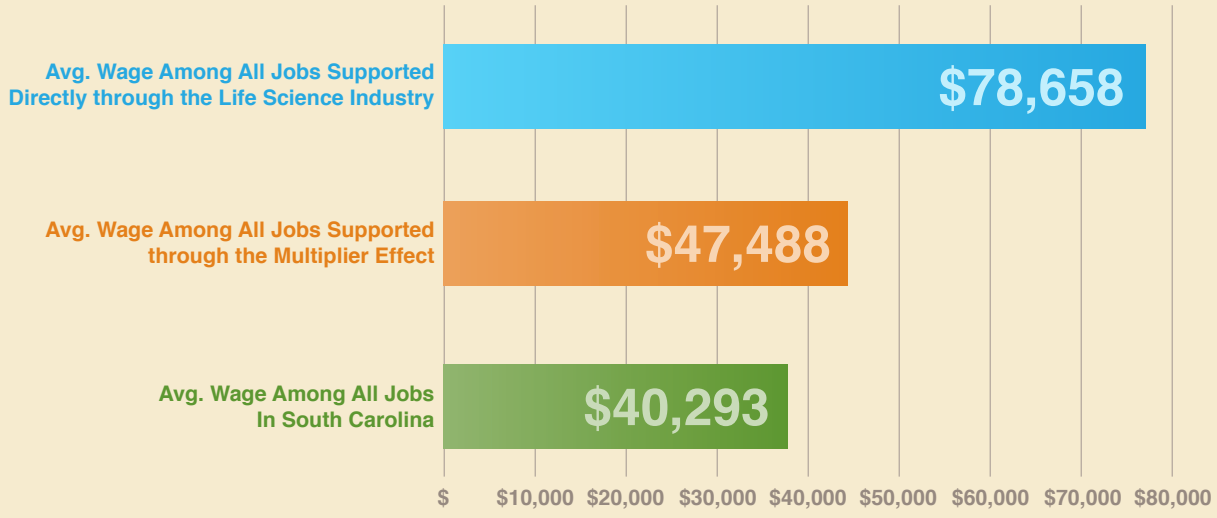
A total of 43,467 jobs are supported in South Carolina's economy as a result of the direct economic activity associated with the life science industry. In other words, the 15,012 jobs in the life science industry give rise to an additional 28,455 jobs in South Carolina. The employment multiplier for South Carolina's life science industry is therefore 2.9 – implying that for every 10 jobs created by the life science industry in South Carolina, an additional 19 jobs are created elsewhere in the state.

"...the life science industry has the ability to scale up employment in South Carolina in a way that few other industries possess."

The importance of this multiplier effect cannot be overstated. To put this into perspective, the average employment multiplier across all industries in South Carolina is 1.9, with very few industries having an employment multiplier above 2.5.[6] Thus, the life science industry has the ability to scale up employment in South Carolina in a way that few other industries possess. This represents a key finding of this study. Investments in the life sciences have the potential to generate significant employment growth for the Palmetto State in the coming years.

The life science industry also contributes to high employment quality – as measured by wage levels. The estimates in Table 2 provide both the number of jobs and the total labor income associated with those jobs, which allows for the estimation of the average wage associated with each. **Figure 2 details these estimates.**

Figure 2 - S.C. Annual Labor Income Comparisons



[6] Source: IMPLAN modeling software; South Carolina estimates for calendar year 2015.

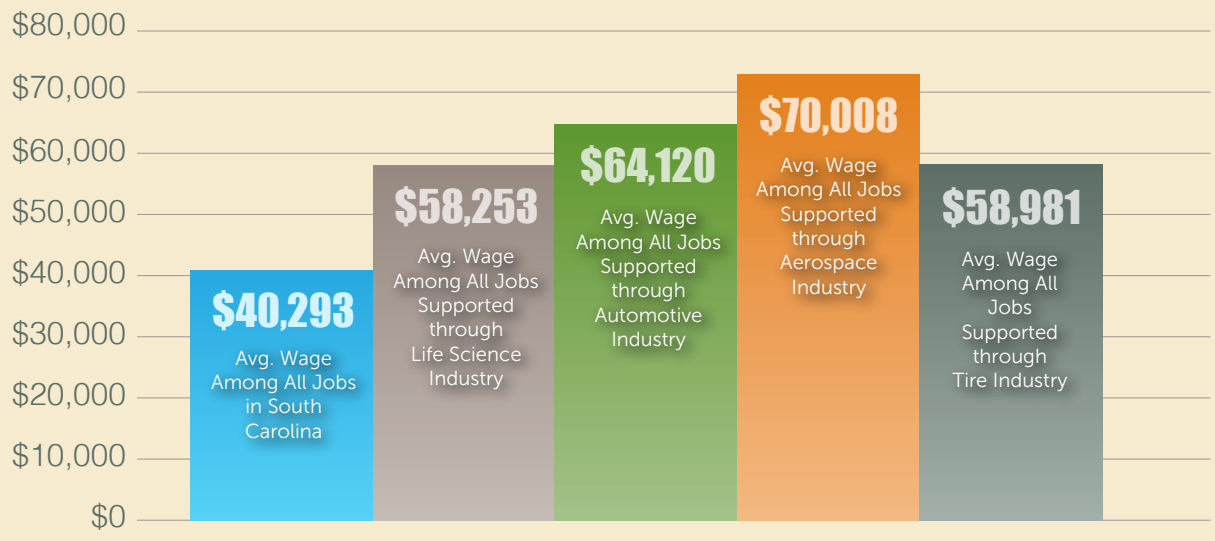
As of 2017, the average job within the life science industry in South Carolina is estimated to pay approximately $78,658 annually. This is nearly double that of the average job in South Carolina. Among all 28,455 jobs associated with the multiplier effect, the average annual wage is approximately $47,488.

"The average job in the life science industry pays nearly twice that of the average job in South Carolina."

Another way to compare these wage estimates is to examine how the average wage across all 43,467 jobs supported by the life science industry (either directly or indirectly) compares to the average wage across all jobs supported (either directly or indirectly) by other leading industries in South Carolina. **Figure 3 explicitly compares the average wage across all life science-related jobs (including those due to the multiplier effect) with those supported through the aerospace, automotive, and tire clusters.**

Figure 3 – Average Wage Among All Jobs Supported by Select S.C. Industries

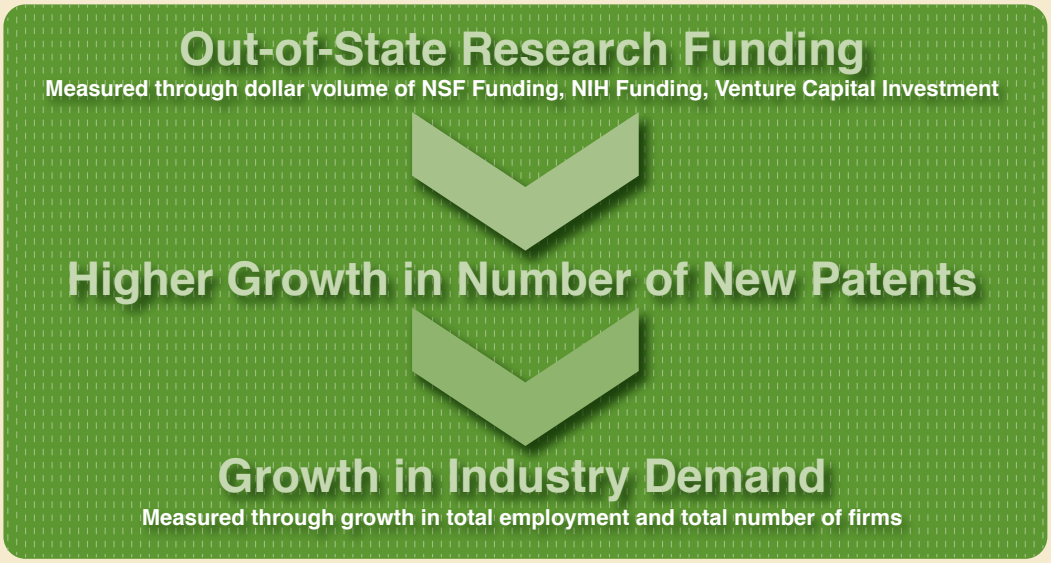
Note: Averages include multipler effects



Section III – Assessing any Academic Research/Business Mismatch in South Carolina's Life Science Industry

Among the many factors that influence the long-run growth prospects of the life science industry in South Carolina is the extent to which federal research dollars entering the state to support academic research in the life sciences help to grow the size and scope of the industry over time. Specifically, if academic research funding is appropriately matched to industry demand, one may expect to see a process in which federal funding leads to various research activities that generate new patents that, in turn, eventually translate into new business activity. **This process of market driven innovation is summarized in Figure 4.**

Figure 4 - The Process of Market Driven Innovation



If a breakdown in this process occurs, it will likely be due to one of two causes: (1) the out-of-state research funding does not result in any new patent activity; (2) the new patents do not represent innovations that have significant market demand in South Carolina. In order to assess whether there is any breakdown in this process in South Carolina – that is, an academic research/business mismatch – data were collected from the following sources to examine each of the three components outlined in Figure 4:

- **Out-of-State Research Funding**[7]
  - National Science Foundation (NSF) Research Grants Awarded in South Carolina
  - National Institutes of Health (NIH) Research Grants Awarded in South Carolina
  - South Carolina Venture Capital Investments
- **South Carolina Patent Activity**[8]
  - Total patents issued in South Carolina
- **Growth in Industry Demand**[9]
  - Total South Carolina employment within the life science industry
  - Total number of South Carolina firms within the life science industry

[7] Sources: NSF Higher Education Research and Development Survey (2015); NIH Awards by Location and Organization (2015); Thomson Reuters Venture Capital Database (2011-2015).
[8] Source: U.S. Patent and Trademark Office (2011-2015).
[9] Source: Hoover's Database (February 2017).

The process of market driven innovation outlined in Figure 4 was examined for the major industry categories within the life science industry. These results are summarized in Tables 3-4 and discussed below.

Summary: Venture Capital Investment and Industry Demand

The innovation sector within South Carolina's life science industry consists of approximately 7,021 employees across 154 firms, as Table 3 denotes. Specifically, this subset of the life science industry excludes all industry NAICS codes previously identified in Table 1 that are not representative of innovation activities. Thus, all categories within Bioscience-Related Distribution were excluded as well as Testing Laboratories (NAICS code 541380) and Medical Laboratories (NAICS code 621511).

Note in Table 3 that all venture capital investment in South Carolina within the life science industry occurred within the Drugs, Pharmaceuticals, Medical Devices, and Equipment categories, which totaled $112.5 million between 2011 and 2015. Additionally, the primary concentration of firms and total employment within the life science innovation sectors are also within this same set of categories (70.1% and 83.7%, respectively). Thus, life science-related venture capital investment in South Carolina appears to be supporting the successful life science innovation sectors.

Table 3 - Percentage of Total Activity within the Life Science Industry by Major Category

	Venture Capital Investment	Firms	Employment
Agricultural Products	0.0%	9.8%	8.3%
Drugs, Pharmaceuticals, Medical Devices, and Equipment	100.0%	70.1%	83.7%
Research, Testing, and Medical Labs	0.0%	20.1%	8.0%
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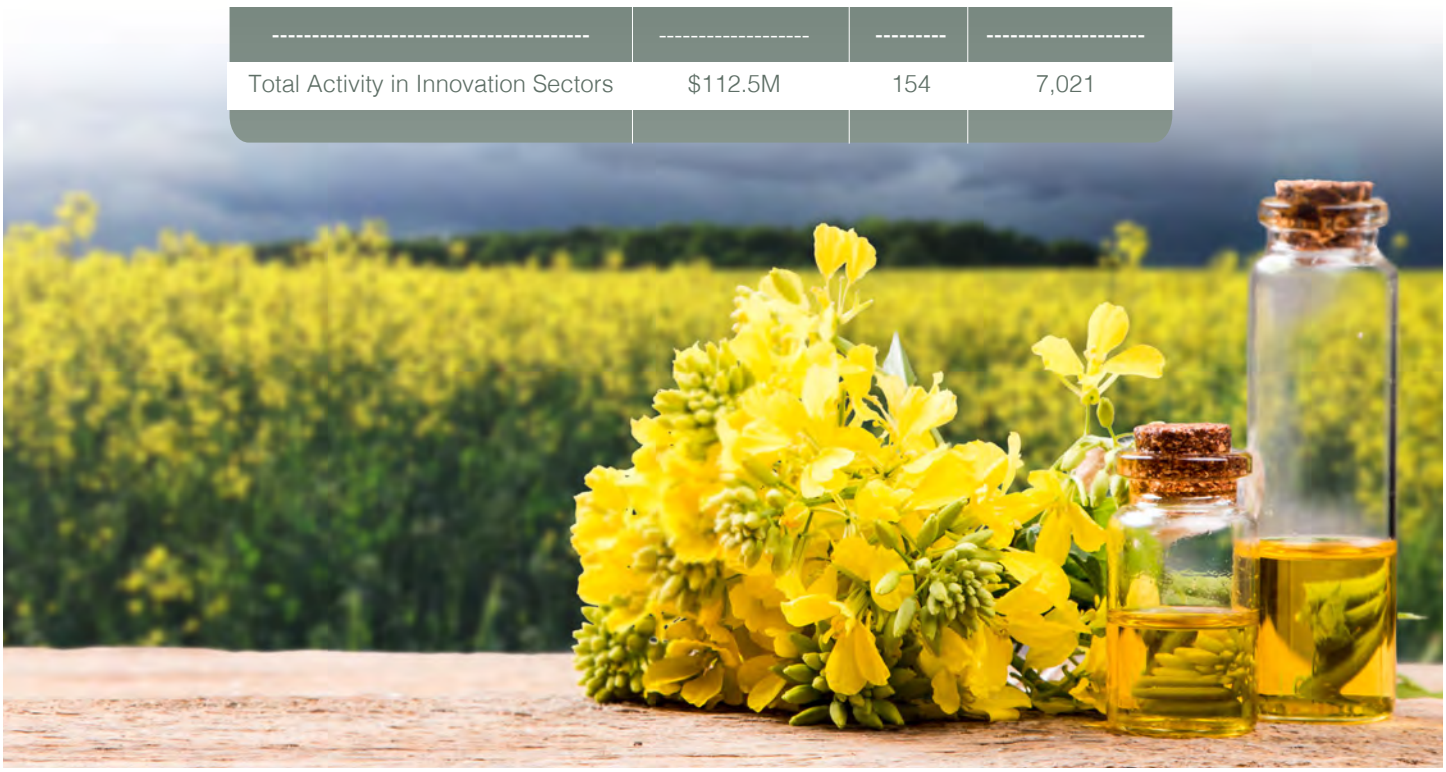
Total Activity in Innovation Sectors	$112.5M	154	7,021



Summary: Patents and Research Funding

Table 4 summarizes the number of patents issued in South Carolina for life science-related activities as well as the total dollar volume of NSF/NIH research funding directed towards life-science related grants. Both of these elements are critically important to the long-run health of the life science industry in South Carolina because they represent the building blocks for its growth. Put simply, ongoing research and new patent activity are measures of the current status of life science-related activities in the pipeline that will contribute to the future growth of the industry. Note that in Table 4, both indicators have shown a postive overall rate of growth since 2012.[10]

Table 4 – Growth in S.C. Patent and Research Funding Activity: 2012-2015[11]

	Patents Issued	NSF/NIH Research Funding
2013	202 (+12.2% YR/YR)	$500.7M (+0.3% YR/YR)
2014	183 (-9.4% YR/YR)	$514.4M (+2.7% YR/YR)
2015	193 (+5.5% YR/YR)	$521.5M (+1.4% YR/YR)
Avg. Annual Growth Rate 2012-2015	+2.4%	+1.6%

[10] There is typically a significant lag (of between six and nine years) between the point at which research grant funding is approved for a project and the point at which a patent based on this research project is issued. More information on average time lags can be found at the U.S. Patent and Trademark Office.

[11] Appendix II provides a detailed breakout of this patent activity

Section IV – A Firm-Level Perspective on the Strengths and Weaknesses of South Carolina's Life Science Industry

Thus far, this report has examined the current size and scope of the life science industry in South Carolina, including the extent to which the process of market driven innovation helps to generate high levels of economic activity within the industry. In order to establish appropriate priorities to grow the industry in the future, however, it is important to examine the strengths and weaknesses of the state's life science industry from a firm-level viewpoint. By gaining an understanding of what firms themselves perceive as the major strengths and weaknesses of the industry, SCBIO and other policymakers will be better able to facilitate positive economic development efforts.

In order to assess the opinions of firms within South Carolina's life science industry, a series of 25 interviews were conducted with firms in the life science industry across South Carolina.[12] Although the markets and geographic regions served by these firms were diverse, the sample consisted of primarily larger organizations. The average annual sales volume for interviewed firms was $34.9 million with an average employment count of 183. Based upon the information obtained from these interviews, this section summarizes and provides three key findings from the interview responses.

Key Finding 1: Firms Generally Expect a Sizable Increase in Market Demand in the Coming Years

When asked about future market trends – and specifically how the market demand for their products/services will likely change – 67 percent reported an expectation of significant growth for their companies in excess of 10 percent per year for the next five years. The remaining respondents also reported an expectation of positive growth, but by less than 10 percent per year. Most cited the aging population and the accompanying overall steady increase in demand for healthcare as the primary reason for this expectation of growth.

An additional factor contributing to this high demand is the growing overlap between advanced manufacturing and the life sciences. For example, multiple firms stated that the market for medical devices is moving towards the creation of devices specifically to aid and support minimally invasive medical procedures. These same types of devices, however, are also in demand in the aerospace, energy, and automotive industries to aid in precision manufacturing.

[12] All interviews were conducted by SCBIO personnel. The survey instrument used appears in Appendix I.

Key Finding 2: Workforce Shortages and Limitations

Firms consistently stated their need for a greater supply of high-skilled workers, especially in the smaller metropolitan regions of South Carolina (e.g., Florence, Sumter). Part of this need stems from the fact that the life science industry in South Carolina is relatively small, which results in a high inflow/outflow of workers to and from the state. For example, one employer stated that when a life science-related company closes, the high-skilled workers often have to leave South Carolina because the industry is not large enough for them to find additional employment within their profession locally. This, in turn, makes it harder for any new firm that later wants to locate in South Carolina to find the workforce that it needs. The Raleigh, NC and Atlanta, GA markets were both cited as major competitors for the state's workforce.

Key Finding 3: South Carolina is Perceived as Having a Positive Business Climate

Firms were asked to state the major advantages and disadvantages of being located in South Carolina. The following represents the major responses given:

Perceived Advantages
- **High Quality Workforce**
- **High Quality of Life**
- **Low Cost of Living**
- **Right to Work State**
- **Close Proximity to the Port of Charleston**
- **Technical College System that Supports Manufacturing**

Perceived Disadvantages
- **A need for additional medical device manufacturers in the life science supply chain**
- **Access to major airports**
- **Difficulty in recruiting top-level talent from outside of the state**
- **R&D is limited in life sciences at South Carolina universities**
- **Perceived quality of K-12 education negatively impacts out-of-state workforce recruitment**

Despite the listed disadvantages, when asked about alternative states or regions that provide a better business climate for the life science industry, only three respondents indicated locations perceived to be superior to South Carolina. These states were Florida, North Carolina, and New Jersey. The primary reason listed for each state was the fact that each has a larger, more developed life science cluster with many of the advantages that this brings (e.g., a more developed supply chain, a larger workforce pool, etc.).

To summarize, the responses from the interview process revealed a generally positive impression of the state of South Carolina's business climate as well as anticipated positive increases in future demand and an increase in the interaction with other manufacturing markets. The major limiting factor identified for the state was the high-skilled workforce shortage. This represents a significant opportunity for South Carolina; effectively addressing this workforce shortage would not only increase the state's overall competitiveness, but also allow South Carolina to fully capitalize on its existing advantages.

Section V – Conclusion

The life science industry has been a major contributor to South Carolina's economy over the past decade. Since 2005, for example, employment growth has averaged approximately 1.7 percent per year, which is more than twice that of the state as a whole over the same time period. A strong life science industry is important to the Palmetto State for many reasons. First, growth in the life science industry supports demand for high-wage, high-skill positions across various STEM fields. Second, growth in the life science industry supports the development of the knowledge economy. Regions across the U.S. with a strong knowledge economy typically have the highest rates of economic growth as well as the highest rates of income growth for their residents. Third, the knowledge economy represents a key factor in boosting a region's rate of productivity growth, which is critical for long-run economic development.

This study has found that South Carolina's life science industry currently consists of approximately 15,012 employees across 402 firms, which supports a total annual economic impact of approximately $11.4 billion in total economic output. This dollar volume of activity is associated with 43,467 total jobs and over $2.5 billion in labor income for South Carolinians. Additionally, the average direct job in the life science industry pays an annual total compensation of $78,658, which is about 95 percent higher than the average annual compensation in South Carolina ($40,293).

The total economic impact of the life science industry is also associated with an employment multiplier of 2.9. In other words, for every 10 jobs that are created within the life science industry in South Carolina, an additional 19 jobs are created elsewhere in the state due to the effects of the employment multiplier. This multiplier effect is one of the highest in South Carolina, meaning that the life science industry has a relatively unique ability to scale up employment.

This study also conducted a review of academic research and private investment in South Carolina's life science industry. This review was then used to determine if any mismatch exists between the academic and investment priorities within the life sciences and general industry demand. The process of market driven innovation whereby research and investment dollars drive patent activity, which then drives additional employment and firm growth, has been found to be largely successful.

Finally, this study provided the results of a series of firm-level interviews of life science companies in South Carolina assessing perceived strengths and weaknesses of the life science industry. The primary results of these interviews indicate that while firms anticipate high market demand and have a favorable view of the overall business climate in South Carolina, they also consistently note that there is a shortage of high-skilled workers in the state. Addressing this need has the potential to improve the state's overall competitiveness and to enhance the long-run growth potential of the life science industry.

Appendix I – S.C. Life Sciences Industry Survey

Part I: Company Overview

Thank you for agreeing to participate in the SCBIO Life Sciences Industry Survey!
Please begin by providing the following information regarding your company's facility:

- Company Name
- Physical Address
- City
- Zip Code
- Phone

Part II-A: Company Production Profile

What are the products produced or services offered at this facility? Please list primary products/services first.

Please estimate the average annual sales volume at this facility:

(a) Less than $1 million
(b) $1 million to $5 million
(c) $5 million to $10 million
(d) $10 million to $50 million
(e) Greater than $50 million

Please estimate the average annual total employment at this facility:

(a) Less than 10 employees
(b) 10 to 50 employees
(c) 50 to 100 employees
(d) 100 to 500 employees
(e) More than 500 employees

What market(s) does this facility serve (e.g., medical, consumer goods, wholesale, retail, etc.)? Please be specific.

Part II-B: Business Operations

For each of the following Business Operations listed, please estimate the NUMBER OF EMPLOYEES at this facility working in each category

- Number of Production/Manufacturing Employees
- Number of Research and Development/Administration Employees

Part III: Future Challenges and Opportunities

How do you anticipate that the market demand for your goods/services will change within the next five years? Please select one:

(a) Increase by more than 10% per year
(b) Increase by less than 10% per year
(c) Stay the Same
(d) Decrease by less than 10% per year
(e) Decrease by more than 10% per year

What market trends are you currently observing that lead you to your answer?

Do you expect to INCREASE, DECREASE, or MAINTAIN your current market share over the next five years? (Increase/Decrease/Maintain)

Over the next five years, I expect employment at this facility to…

(a) Increase by more than 10% per year
(b) Increase by less than 10% per year
(c) Stay the Same
(d) Decrease by less than 10% per year
(e) Decrease by more than 10% per year

Over the next five years, I expect production at this facility to…

(a) Increase by more than 10% per year
(b) Increase by less than 10% per year
(c) Stay the Same
(d) Decrease by less than 10% per year
(e) Decrease by more than 10% per year

What do you view as the primary obstacles to achieving your corporate goals? These can be related to any of the following: market growth, hiring or workforce development, access to working capital, access to research partnerships, locating suppliers, locating customers, production costs/flexibility/quality

Please provide three specific examples of actions that you would like to see taken by SCBIO or the state of South Carolina that would best help your business over the next five years.

Please describe what you see as the top 3 advantages and the top 3 disadvantages of being located in South Carolina.

Are there other states/regions that you believe provide a better business climate for the life sciences industry and your facility in particular than South Carolina? If so, which states/regions and why? Please be specific.

Appendix II – S.C. Patents in the Life Sciences Issued between 2011 and 2015

Description	Number of Patents Issued	Associated NAICS Code
Food or Edible Material: Processes, Compositions, and Products	13	3112
Fuel and Related Compositions	4	3251
Gas Separation: Processes	12	3251
Chemistry of Inorganic Compounds	16	3251
Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making	6	3251
Chemistry: FischerTropsch Processes; or Purification or Recovery of Products Thereof	1	3251
Chemistry of Hydrocarbon Compounds	2	3251
Boots, Shoes, and Leggings	4	3252
Solid AntiFriction Devices, Materials Therefor, Lubricant or Separant Compositions for Moving Solid Surfaces, and Miscellaneous Mineral Oil Compositions	2	3252
Synthetic Resins or Natural Rubbers (includes Classes 520528)	70	3252
Receptacles	30	3254
Drug, BioAffecting and Body Treating Compositions (includes Class 514)	137	3254
Chemistry: Molecular Biology and Microbiology	66	3254
Chemistry: Natural Resins or Derivatives; Peptides or Proteins; Lignins or Reaction Products Thereof	3	3254
Organic Compounds (includes Classes 532570)	26	3254
Geometrical Instruments	16	3345
Measuring and Testing	63	3345
Woodworking	2	3345
Automatic Temperature and Humidity Regulation	1	3345
Radiant Energy	25	3345
Electricity: Measuring and Testing	44	3345
Communications: Directive Radio Wave Systems and Devices (e.g., Radar, Radio Navigation)	1	3345
Optics: Measuring and Testing	23	3345
Horology: Time Measuring Systems or Devices	2	3345
XRay or Gamma Ray Systems or Devices	2	3345
Optical Waveguides	56	3345
Chemical Apparatus and Process Disinfecting, Deodorizing, Preserving, or Sterilizing	21	3345
Chemistry: Analytical and Immunological Testing	14	3345
Surgery: Light, Thermal, and Electrical Application	3	3345
DP: Vehicles, Navigation, and Relative Location (Data Processing)	41	3345
DP: Measuring, Calibrating, or Testing (Data Processing)	26	3345
Surgery (includes Class 600)	29	3391
ElongatedMemberDriving Apparatus	3	3391
Thermal Measuring and Testing	6	3391
Dentistry	5	3391
Abrading	10	3391
Surgery: Kinesitherapy	1	3391
Surgery: Splint, Brace, or Bandage	5	3391
Surgery (Medicators and Receptors)	51	3391
Surgery (instruments)	32	3391
Prosthesis (i.e., Artificial Body Members), Parts Thereof, or Aids and Accessories Therefor	25	3391
Totals	**899**	**N/A**